A clean copy of all of the claims is attached together with a marked-up copy of the claims with changes.

Remarks

The present application has been carefully studied and amended in view of the outstanding Office Action dated December 8, 2000, and reconsideration of that Action is requested in view of the following comments.

A petition for a three month extension of time accompanies this Response together with the appropriate fee thereby extending the deadline until June 8, 2001. This Response is timely filed since it was deposited in the mail for first class delivery on the date certified on the front page thereof.

Claims 8, 9, 13, 15, 20 and 21 have been carefully studied and amended to address the informalities noted by the Examiner in the Office Action. Specifically, claims 9, 13, 20 and 21 define a particle size of about 128-458 nm, and these claims now recite an increase of about 10-15 nm from the dry pigment particles. Also, claims 8, 13, 15, 20 and 21 now recite that the ink has a conductivity of μS/cm. Accordingly, it is believed that all of the claims are now in proper form and in full compliance with 35 USC §112.

Applicant respectfully submits that claims 1-21 define patentable subject matter which is not suggested by Fujimatsu et al US 5,913,971 ("Fujimatsu") in vew of Anton et al US 6,005,023 ("Anton") or Ma et al US 5,085,698 ("Ma"), Tsutsumi et al US 5,852,074

("Tsutsumi"), Sano et al US 5,324,349 ("Sano") and either Lin et al US 5,531,818 ("Lin") or Nigam et al US 5,693,127 ("Nigam"), for the reasons expressed below.

Similarly claims 1-10, 13, 14, 17, 18 and 20 are not rendered obvious by Noguchi et al US 5,658,376 ("Noguchi") in view of either Anton, Ma, Tsutsumi, Sano and either Lin or Nigam, for the reasons expressed below. Also, claims 1-5 and 11 are not rendered obvious by the combination of Sano in view of Anton or Ma and Tsutsumi, for the reasons expressed below.

Applicant respectfully submits that the present invention as defined in the claims is directed to an ink composition suitable for use in ink jet printers. This unique ink composition comprises an ethanol-water vehicle, a dispersant resin solublized by an ammonium hydroxide, a translucent acrylate emulsion or a hyperdispersant, a pigment and a defoamer. The ink is stable in storage, water fast after printing and scratch resistant with a high gloss. Moreover, the ink has a neutral pH, a low viscosity, and is friendly to the environment. No such ink composition is disclosed or suggested by the prior art taken alone or in combination with one another.

The present invention is significantly different from Fujimatsu in the amount required of the ingredients of the ink formulation and their specific role and effectiveness and the stability of the ink. The present invention is also different from Fujimatsu along with Anton or Ma in the use of ammonium hydroxide. In the prior art, the dispersing agents are neutralized either by morpholine, diethanolamine, aliphatic amines and amine alcohols. One noteworthy difference of the present invention is in the ionization

of the neutralizing agents and the extent thereof along with heat of vaporization. Applicant took advantage of the ionization constant, and specification of the ionizing agent in neutralizing the dispersing agents. Although Anton and Ma disclose the interchangeability of amines disclosed by Fujimatsu with ammonium hydroxide as a potential neutralizing agent, yet in all cases they have completely neutralized the dispersing agents. One with ordinary skill in the art must infer that ammonium hydroxide was removed by heating, while in the present invention the dispersant is not completely neutralized for solubilization.

In the present invention, the percent ionic form of the resin is miscible in the vehicle, in this case water and/or a water alcohol mixture. The ionized solvated fraction of the resin will in turn anchor the pigment particle through the functional group on the surface modified pigment particle. Because of this driving force, the equilibrium is shifted to the right producing more and more ionized fraction with the least amount of ammonium hydroxide. The range of this partial neutralization technique is 15-45%, preferably 20-30%. Hence, the present ink composition is very stable at room temperature and this formulation does not require any heating for dispersion stabilization at neutral conditions. In the prior art, the aqueous carrier medium is water or a mixture of water and water soluble organic solvents. Anton and Ma cite examples of water polyhydric alcohol and water alcohol mixtures, among which polyhydric alcohol such as diethylene glycol is preferred for the solubility towards dispersing resin. In the

present invention, the ingredients of the ink formulation are environmentally acceptable with little, if any, ammonia odor in the ink.

Tsutsumi discloses the use of 0.005-0.5% anti-foaming agent in a particular formulation comprising hydrophobic dye, e.g. oil dye, disperse dye, direct dye, acid dye and basic dye, preferably dissolved in organic solvent. The present invention is different in that an anti-foaming agent is used along with an acrylic emulsion which not only enhances optical density but also balances the pH and conductivity which are vital properties for inks used in ink jet printers.

Sano discloses an ink composition where it is preferred to use pigments having a high affinity for water. The composition comprises pigment, saccaharides or a particular polyol and resin emulsion. The present invention is different in the sense that applicant has developed an appropriate agent for dispersion of a pigment which is hydrophobic in nature. This dispersion is subsequently treated with other ingredients for attaining a high quality ink composition. The emulsion used also serves as a binder for enhancing the adhesion of ink onto the substrates as well as enhancing the optical attributes.

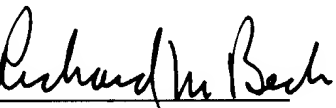
Although Lin and Nigam disclose a conductivity range which is very typical for ink jet inks, applicant herein has specifically recited the conductivity range as well as a new means of optimizing the conductivity with particle size and mobility for the control of flow properties of the ink. Noguchi is also different in that the present invention uses the species distribution of the dispersant in-situ for pigment dispersion, stability of the dispersion, conductivity and the stability of the finished product. Also, applicant uses

an anti-foaming agent and acrylic emulsion (without any neutralization protocol) for enhancing the fixing properties of the ink on the substrates and optical attributes. Noguchi discloses that the dispersant polymer is a water soluble resin or a resin neutralized with alkali to make it soluble. The present invention does not use the neutral bulk media for pigment dispersion or solubilization. On the contrary, the vehicle of the desired property is auto-formed as dispersion progresses in-situ. Clearly this art of utilizing chemistry for the invention of new technology is totally beyond the scope of one's ordinary skill.

Accordingly, in the absence of additional prior art of increased pertinency, it is clear that the present invention as defined in the claims is indeed patentable and notice to that effect is respectfully requested.

Respectfully submitted,

CONNOLLY, BOVE, LODGE & HUTZ, LLP

By 

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1. An ink comprising about 30-90% ethanol-water vehicle, about 2-20% dispersant resin solublized by ammonium hydroxide, a component selected from about 2-9% translucent acrylate emulsion or about 2-5% hyperdispersant, about 1-12% pigment and 0.5-5% defoamer.

2. The ink according to claim 1, wherein the dispersant resin is a styrene acrylate copolymer.

3. The ink according to claim 1, wherein the pigment is carbon black powder.

4. The ink according to claim 1, wherein the translucent acrylate emulsion contains 40-50% polymer.

5. The ink according to claim 1 further comprising a surfactant, a biocide, additional hyperdispersant or a humectant.

6. The ink according to claim 1, having a pH from about 7.2 to about 7.85.

7. The ink according to claim 1, having a viscosity from about 2.5 to about 2.8 centipoise.

8. The ink according to claim 1, having a conductivity from about 2800-9800 μS/cm.

9. The ink according to claim 1, having a particle size of about 128-450 nm, and showing an increase of about 10-15 nm from the dry pigment particles.

10. The ink according to claim 1, having a an equilibrium surface tension of about 25-42 mN/m.

11. The ink according to claim 1, comprising about 50-60% ethanol-water vehicle, about 8-9% dispersant resin solublized by ammonium hydroxide, about 5% translucent acrylate emulsion or about 3-3.5% hyperdispersant, about 5-9% pigment and about 0.8-1.1% defoamer.

12. The ink according to claim 11 further comprising about 1.5-2% humectant, an additional about 1-1.5% hyperdispersant, about 0.1-2.5% surfactant or about 0.3-0.4% biocide.

13. An ink having a conductivity from about 2800-9800 μS/cm, a particle size of about 128-450 nm, and showing an increase of about 10-15 nm from the dry pigment particles and an equilibrium surface tension of about 25-42 mN/m.

14. The ink according to claim 13 comprising about 2-20% dispersant resin solublized by ammonium hydroxide, about 1-12% pigment and about 30-90% water-EtOH vehicle.

15. The ink according to claim 13 wherein the conductivity is about 5500-6000 μS/cm, the particle size is about 280-300 nm, the equilibrium surface tension is about 36 mN/m, and comprising about 8-9% dispersant resin solublized by ammonium hydroxide.

16. The ink according to claim 15 further comprising about 5-9% pigment and water-EtOH vehicle.

17. The ink according to claim 16, wherein the dispersant resin is a styrene acryate copolymer, the pigment is carbon black powder, the pH is about 7.2-7.85, the viscosity is about 2.5-2.8, and further comprising 2-9% translucent acrylate emulsion containing about 40-50% polymer, and an optional ingredient selected from surfactant, biocide, hyperdispersant or humectant.

18. A method of printing comprising the steps of (a) applying to a substrate an ink-jet ink comprising ethanol-water vehicle and about 2-20% dispersant resin solublized by ammonium hydroxide, about 2-9% translucent acrylate emulsion or about 2-5% hyperdispersant, about 1-12% pigment and about 0.5-5% defoamer; and (b) volatilizing the ammonia to fix the ink to the substrate.

19. The method according to claim 18, wherein the ink comprises ethanol-water vehicle and about 8-9% dispersant resin solublized by ammonium hydroxide, about 5% translucent acrylate emulsion or about 3-3.5% hyperdispersant, about 5-9% pigment and about 0.8-1.1% defoamer.

20. The method according to claim 18, wherein the ink has a conductivity from about 2800-9800 μS/cm, a particle size of about 128-450 nm, and showing an increase of about 10-15 nm from the dry pigment particles and an equilibrium surface tension of about 25-42 mN/m.

21. The method according to claim 18, wherein the ink has a conductivity from about 5550-6000 μS/cm, a particle size of about 280-300 nm, and showing an increase

of about 10-15 nm from the dry pigment particles and an equilibrium surface tension of about 36 mN/m.